Author Responses in ***bold italics***

Dear editor, dear authors,

I greatly apologize for the delay in this review, and I hope that its generally positive tone can compensate for the long waiting time. The delay is related to my recent move to another hemisphere and a heavy proposal deadline. Since it is the first time I am reviewing a scientific article in a data format, I was unsure what contents and structure are expected in such publications. Thus, my recommendations focus on the necessary improvements in the clarity and interpretation of the results rather than on requirements for the manuscript structure. Nevertheless, I do agree with Tobias that the format of a technical report is hardly appropriate for a scientific publication in a high-impact journal like the ESSD, with a discussion section painfully missing and the summary section being too brief.

Currently, the manuscript reads almost like a mini article (i.e., a correspondence type), except for its enormous appendix section. Maybe it fits the expected format of ESSD manuscripts, but there are some additions that are necessary to make it easier to follow its arguments and understand the interpretation of the dataset. I hope the recommendations that Tobias and I have provided are useful to achieve such a transformation. Given the above thoughts, I recommend the publication of this manuscript after moderate revisions.

> ***We thank the reviewer for her help in improving our manuscript. We have extensively revised the text to improve clarity and rigor.***

Specific comments:

This article presents an important dataset - a new inventory of glaciers and perennial snowfields for the entire western US that has been long overdue. Most glaciated regions in the world, especially in the "collective West", undergo repeated country- and region-scale inventories of cryospheric landforms on a regular basis, and it is somewhat surprising that such inventories are missing in the western US. I think it would be great to include a paragraph in the introduction section explaining the reasons for why systematic mapping of glacier and snowfield changes has not been done on a regular basis.

> ***The reviewer is correct that an updated inventory of the western US is long overdue and I suppose it is surprising that regular inventory updates are missing. Indeed, the US does a much better job in Antarctica and Greenland. The cause may be due to our science funding structure. The National Science Foundation's Polar Programs is limited, by law, to the Polar Regions. For the western US funding is derived from other broader natural science programs. And I suppose the federal agencies, such as the US Geological Survey, who might normally do such studies are overworked and under-funded. In short, tracking glacier change in the western US is not a priority. For the future, I don't see regular mapping becoming a priority. Regarding the reviewer's recommendation for a paragraph explaining the lack of regular systematic mappings, I don't see how that adds to the report. There are lots of things that should be done that are not.***

I am wondering about the statement in the introduction section (lines 59-61) that "automated schemes are known to misclassify debris-covered ice". I do not agree with this generalization, since most recent

studies have shown that machine learning algorithms can assist the mapping of complicated landforms such as debris-covered and rock glaciers when surface movements (associated with periglacial/glacial processes) are mapped in time and using a combination of satellite products, resulting in a relatively high precision of mapping compared to manual (e.g., Lu et al., 2022; Robson et al., 2020). I think this recent development deserves some space in the introduction and also in the currently missing outlook (i.e., future technological improvements).

Revised

It is also relevant to mention here the statement from lines 84-85 – if a long-term surface movement could be automatically tracked, one would not need to rely on such superficial criteria as the presence of crevasses. For example, in Norway there are several major ice caps that are nearly completely void of crevasses and thus do not qualify as glaciers according to the established criteria. In contrast, in the Andes, there are glaciers that are surrounded by snow/ice penitents that might appear as crevasses from above but are not part of the glaciers. Such exceptions exist in every glaciated part of the world, albeit with regional differences. Hence, possible future upgrades of the mapping methods need to be discussed in the "future perspectives" to avoid such limiting assumptions.

We agree that surface movement detected from the appearance of crevasses could be improved in the future by automatically tracked movement. Given that the technology is on the cusp of provided that service, we do not feel it needs to be discussed in a 'future perspectives.

When reading through the text, there are several references to the appendix section that discusses individual cryospheric landforms causing various complications when being mapped or showcasing common unusual behavior. I think it is counterintuitive that in these instances, the article sends its reader to the appendix and its different sections. I believe that many of these belong to the discussion and should be visualized by two additional figures in the main text, including multiple insets corresponding to different issues encountered during mapping and different phenomena observed. These can both feed the non-existing discussion and provide support to the claims in the article that are poorly grounded right now, since the reader must read additional sections from the appendix to visualize and validate them. Furthermore, references to the interesting cases presented in the appendix are not providing a complete picture. I believe they could be strengthened in the main text by adding more examples from the appendix and crafting good visualizations.

The text and figures regarding the difficult cases was moved from the appendix to the main body of the paper.

The methods section related to the "uncertainty" has two main issues. First, the strategy for estimating uncertainties seems random and non-mathematical (at least in part). Could the authors explain why they decided to adapt such strategies and how they relate to other existing studies with similar objectives (especially, those that are more mathematically grounded)? Ideally, this should be done in the new discussion section. Also, large parts of the uncertainty section read like a discussion to me. I think this is where they should be relocated.

This section was revised to better explain our methods. It should remain in Methods.

Finally, the results section has two paragraphs of text and is not attached to any discussion. I understand it is a data article but… two paragraphs? Is there nothing more to write about these data in the main text?

Agreed. Text was revised.

Technical edits:

Lines 23 – 24: This needs to be expanded. Also, in lines 21 – 34 and in the article, the hazardous nature of glaciers can be included as a motivation (glacial lake outburst floods, glacier collapses and avalanches, etc.) in addition to their function as freshwater resources.

Considering that this report is about a glacier inventory and not about glacial hazards, we think the brief summary and pointers provided here to the hazard literature is sufficient.

Line 39: A reference to Andreassen et al. (2022) could be useful here.

Added

Lines 107 – 112: This text needs further clarification. It is a bit hard to follow.

Revised

Correct grammar/errors in lines 49, 57, 64, 142, and 181.

Edited all we could find

References:

Andreassen, L., Nagy, T., Kjøllmoen, B., and Leigh, J. (2022). An inventory of Norway's glaciers and ice-marginal lakes from 2018-19 Sentinel-2 data. Journal of Glaciology, 68(272), 1085-1106, doi: 10.1017/jog.2022.20.

Robson, B.A., Bolch, T., MacDonell, S., Hölbling, D., Rastner, P., and Schaffer, N. (2020). Automated detection of rock glaciers using deep learning and object-based image analysis, Remote Sensing of Environment, 250, 112033, doi: 10.1016/j.rse.2020.112033.

Lu, Y., Zhang, Z., Kong, Y., and Hu, K. (2022). Integration of optical, SAR and DEM data for automated detection of debris-covered glaciers over the western Nyainqentanglha using a random forest classifier, Cold Regions Science and Technology, 193, 103421, doi: 10.1016/j.coldregions.2021.103421.

Citation: https://doi.org/10.5194/essd-2022-369-RC2